The off-gas is directed out of heat exchanger off-gas outlet **68** to a suitable separating means for exposing the off-gas to conditions sufficient to remove at least a portion of an intermediate component from the off-gas. In one illustration, the separating means is scrubber **82**. The off-gas is directed through scrubber off-gas inlet **84** and then through scrubber **82** to scrubber off-gas outlet **86**.

Scrubber fluid **88** is directed from scrubber fluid source **90** to scrubber **82** by a suitable means, such as by gravity or by a pump, not shown. Scrubber fluid **88** is introduced to scrubber **82** at a temperature suitable for removing at least a portion of the component from the off-gas.

It is to be understood that additional separating means can be employed to separate components from off-gas discharged from reactor **16**. For example, a suitable cyclone separator, not shown, and a suitable spray drier, also not shown, can be disposed between heat exchanger **64** and scrubber **82**.

Liquid composition **92** is formed by scrubbing of the off-gas with scrubber fluid **88**. Liquid composition **92** is directed from scrubber **82** to reactor **12**. In one embodiment, liquid composition **92** is pumped through piping **94** by pump **96** to the feed inlet tube **35**. Examples of suitable pumps include a centrifugal pump, a positive displacement pump, etc. Liquid composition **92** is thereby combined with the feed for introduction into molten metal bath **44** through tuyere **28**. In another embodiment, liquid composition **92** is directed through piping **97** by pump **99** to conduit **51**. Liquid composition **92** is thereby combined with the feed stream for introduction into reactor **12** and onto molten metal bath **44**.

At least a portion of the off-gas components are thereby returned in liquid composition **92** from the off-gas to molten metal bath **44**. A substantial portion of the discharged feed components are then chemically reformed to shorter-chain unsaturated hydrocarbons, such as ethylene. Chemical reaction of the feed components in system **10** is thereby controlled.

The invention will now be further and specifically described by the following examples. All parts of percentages are by weight unless otherwise stated.

EXAMPLE 1

A 20 lb. hot metal-capacity unit was used for the experimental trials, with a susceptor/crucible arrangement used for containment and heating. The off-gas was sealed to a gas-handling train for analysis. In order to minimize the complexity associated with solids handling, isomeric surrogates of polyethylene were used. The injection was achieved by bubbling inert gas through the liquid hexane to yield an inlet concentration given by the vapor pressure of hexane. The gas mixture was subsequently bubbled into the molten metal bath, with steady state being achieved after 15 minutes.

The results of these scoping experiments are summarized in Tables 1 and 2 below.

TABLE 1

Metal Substrate	Temperature ° C.	Feed	Concentration (%)	Ethylene Selectivity (%)
Brass	1050	n-hexane	18	2
Brass	900	n-hexane	18	35
Brass	900	n-hexane	31	30

TABLE 2

Metal Substrate	Temperature ° C.	Feed	Concentration (%)	Ethylene Selectivity (%)
Aluminum	900	n-hexane	6	<0.5
Aluminum	900	n-hexane	13	22
Aluminum	900	2-methyl-pentane	18	19

EXAMPLE 2

A 20 lb. hot metal-capacity unit was used for the experimental trials, with a susceptor/crucible arrangement used for containment and heating. Various organic liquids were fed and the production of unsaturated organics was monitored. Feed addition was achieved by vaporizing the organic and sweeping it with an inert gas to achieve the desired inlet concentration. The gas mixture was subsequently added into the molten metal bath with steady state being achieved after 15 minutes. The results are summarized below.

TABLE 3

Metal Substrate	Temperature ° C.	Feed	Concentration (%)	Ethylene Selectivity (%)
Copper	900	n-hexane	18	35
Aluminum	900	n-hexane	13	22
Aluminum	900	2-methyl-pentane	18	19

Equivalents

Those skilled in the art will recognize, or be able to ascertain using no more than routine experimentation, many equivalents of the invention described specifically herein. Such equivalents are intended to be encompassed in the scope of the following claims.

What is claimed is:

1. A method for reforming hydrocarbons into shorter-chain unsaturated organic compounds, comprising the steps of:

a) providing a molten metal bath, said molten metal bath consisting essentially of an elemental metal which can cause cleavage of at least one carbon-carbon bond of a hydrocarbon component of a hydrocarbon-containing feed;

b) directing said feed into the molten metal bath at a rate which causes the concentration of carbon in the molten metal bath to be lower than the saturation limit for carbon of said bath at the operating conditions of said molten metal bath, whereby the hydrocarbon component of the feed can exhibit cleavage of at least one carbon-carbon bond of the hydrocarbon component of said feed; and

c) establishing and maintaining conditions in said molten metal bath to cause cleavage of at least one carbon-carbon bond of the hydrocarbon component to produce unsaturated organic compounds, as products of said cleavage.

2. A method of claim 1 wherein the molten metal bath includes a transition metal component.

3. A method of claim 1 wherein the molten metal bath provided has a melting point of greater than about 500° C.

4. A method of claim 1 wherein the molten metal bath provided has a metal equilibrium carbon solubility of greater than about 0.01% by weight.

5. A method of claim 1 wherein the hydrocarbon-containing feed is directed into the molten metal bath at a rate which causes the residence time of a carbon component of the feed to be greater than that required to cause the molten metal bath to dissolve said carbon under the operating conditions established and maintained in the molten metal bath.

6. A method of claim 5 wherein the hydrocarbon component of said feed includes an alkyl compound.

7. A method of claim 6 wherein the organic hydrocarbon component includes an alkane.

8. A method of claim 5 wherein the hydrocarbon component includes an aryl compound.

9. A method of claim 5 wherein the operating conditions of the molten metal bath include establishing and maintaining a temperature in a range of less than about 2,000° C.

10. A method of claim 9 wherein the hydrocarbon-containing feed is directed into the molten metal bath as a component of a fluid stream that includes an inert gas component.

11. A method of claim 9 wherein the concentration of the hydrocarbon-containing feed in the fluid stream is in the range of between about five and forty percent, by volume.

12. A method of claim 11 wherein the hydrocarbon is a component of oil.

13. A method of claim 11 wherein the hydrocarbon component of the feed includes polyethylene.

14. A method of claim 5 wherein a bath of molten brass is provided.

15. A method of claim 5 wherein a bath of molten aluminum is provided.

16. A method of claim 1 where the hydrocarbon-containing feed contains heteroatoms.

17. A method of claim 16 where the heteroatoms include sulfur, nitrogen, oxygen, and chlorine.

* * * * *

18. <u>(Added) An apparatus suitable for closed and sealed molten metal-based reactions comprising: (a) an upper portion, wherein the upper portion is characterized by an off-gas outlet; (b) a lower portion wherein the lower portion is characterized by one or more inlets suitable for introducing one or more lances; (c) an induction coil disposed within the lower portion; (d) a means for controlling (1) the rate of introduction of the feed streams, (2) the rate of removal of the off gas, (3) the relative amounts of reaction components, (4) the temperature of the molten metal; and/or (5) the carbon saturation levels of the molten metal bath within residence times of between 0.1 and 5 seconds.</u>

19. <u>(Added) The apparatus of Claim 18 further comprising one or more additional feed inlets in the apparatus.</u>

20. <u>(Added) The apparatus of Claim 18 wherein the feed inlets are adapted for the introduction of a carbon-containing material and/or a gas component including argon.</u>